VALUATION OF INTERNATIONAL OIL COMPANIES - THE ROACE ERA

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CESIFO WORKING PAPER NO. 1412
CATEGORY 8: RESOURCES AND ENVIRONMENT
FEBRUARY 2005

CESifo *Working Paper No. 1412*

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Abstract

High oil prices are normally expected to stimulate exploration and the development of new oil and gas fields. But over the last few years, financial analysts have focused strongly on short-term accounting return (RoACE) for benchmarking and valuation, and this has led to high capital discipline among oil and gas companies. We analyse how high oil prices can be explained in terms of an implicit capacity game between the oil companies, and explore the stability of the current equilibrium. Our approach is an investigation of a key assumption among financial analysts, namely the presumed positive relation between RoACE and stock market valuation. Based on panel data for 11 international oil and gas companies, we seek to establish econometric relations between market valuation on one hand, and simple financial and operational indicators on the other. Our findings do not support the perceived positive relation between reported RoACE and market-based multiples. Recent evidence also suggests that the stock market is increasingly concerned about reserve replacement and sustained profitable growth. The current high-price equilibrium is therefore hardly stable.

JEL Code: M41, M21.

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We are thankful to Statoil and The Norwegian Research Council for financial support. We thank for constructive comments at the Annual Conference of International Association for Energy Economics (IAEE), Tehran, May 25. – 27, 2004, and at a seminar at Norwegian School of Economics and Business Administration, September 7, 2004.

1. Introduction

The current high oil prices are being linked to the lack of investments in the oil sector.

"*I am disappointed about the shortfall of investments on the supply side. Large, international oil companies seem to prefer looking for oil at the NYMEX trading floor, instead of exploring for resources around the world. They have a social responsibility, but prefer to buy back their own shares*," Fatih Birol, Chief Economist, International Energy Agency (IAE)

To explain the recent high oil prices, both the supply- and the demand-side behaviour need to be taken into consideration. On the supply side, global exploration level has been low since 1998. As an example, cf. the development in exploration wells in the USA in Figure 1.

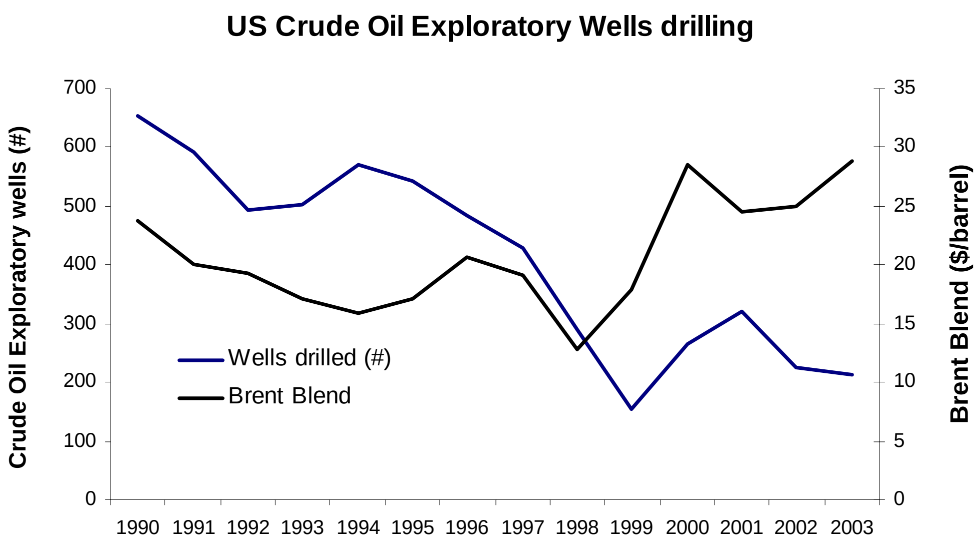

Figure 1: Number of exploration wells in the USA versus oil price, 1990-2003. Source: *US Department of Energy*

Empirical research suggests that cash-flow variables dominate capital-cost variables in the explanation of investment behaviour. Oil and gas exploration is no exception. Current cash flows among oil and gas companies are fuelled by high oil and gas prices, and risky investments like exploration are usually funded by internal funds. Adaptive expectations may also cause price expectations to increase in periods of high spot prices. However, the relationship between exploration activity and the oil price seems to have disintegrated over the last few years. Instead, the huge cash flows that have been built among oil and gas companies find their way back to investors, through increased dividends and share buyback programmes.

At the same time, there has been an increasing focus in the oil industry on short term accounting profitability, or more precisely, Return on Average Capital Employed (RoACE), which is a vital input to valuation analyses done by investment banks. This indicator has its flaws. RoACE is not neutral over a project's life cycle. Inherent in the unit of production depreciation system in the oil sector, RoACE falls in the first years when new investments are undertaken. Later in the project cycle, RoACE will rise. Reversely, RoACE is boosted in periods of divestment. The short-term negative effect on corporate income accounts is particularly strong for exploration expenses as only successful wells are capitalized; costs related to dry holes are expensed. As the lead times for exploration projects are generally long, the focus on short-term return on capital caused a shift in management attention to cost cutting and value-maximisation of existing reserves (efforts to increase oil recovery).

In effect, the strong focus on RoACE by analysts and investment banks may therefore have put a cap on oil companies' investment budgets. This would not have been the case if a reasonable trade-off were made between short-term profitability and long run growth (development of new reserves).

The oil companies' focus on RoACE, at the expense of organic reserve replacement, has the characteristics of an implicit co-ordination of capacity in the non-OPEC area. We should emphasise that we are not talking of a cartel in a traditional sense, as no collusion has taken place. Rather, our point is that the market outcome, of oil companies independently attempting to score on analysts' rankings of financial indicators - in the particular period we analyse - has some of the same qualitative features as a production cartel.

Another conclusion of our study is that the stock market seems not to have bought into the analysts' tendency to over-weight RoACE. Investors are probably concerned that the short-term return on capital is unsustainable, and would therefore like a more balanced trade-off between short-term indicators like return on capital and long-term indicators like reserve replacement. There is now more focus on reserve replacement and signs of a higher risk acceptance for new projects. Thus, we do not perceive the market equilibrium of strong capital discipline and short-term focus to be stable, i.e., the period 1997-2001 stands out as a fairly unique period of high cash flows and low investments.

In this article we present and analyse financial indicators used in the petroleum industry and present previous literature. Furthermore, we try to ascertain if an equilibrium of low capacity is sustainable. To do so, we undertake econometric testing the actual relation between pricing multiples and financial indicators for oil companies, and test whether the presumed positive relationship between pricing multiples and RoACE actually exists.

In presentations of their valuation techniques, investment banks often picture the relationship between market capitalisation (or EV/DACF) and a single financial indicator (like RoACE) in a diagram. They typically show this relationship for different companies at a given point of time. We take this approach a significant step further, by controlling for other variables that can influence the multiple – like reserves. Furthermore, we apply a panel data set that offers observations of the relationship over five years. Thereafter, we compare our findings with common analyst perceptions.

2. A capacity game in the oil industry

In the vocabulary of game theory, the financial analysts' focus on RoACE-benchmarking has served as a focal point[2] for the international oil companies, securing cartel stability. We will illustrate this by a very simple example. Say the oil industry consisted of only two companies that were to select one of two strategies: exploration (for growth) or passivity (for short-term profitability).[3] A possible payoff matrix for the game could be:

Table 1. Payoff matrix in simplified capacity game.

		Company 2	
		Passive	Explore
Company 1	Passive	125, 125	75, 150
	Explore	150, 75	100, 100

The numbers in each cell give the payoff to company 1 and 2, respectively. Observe that there is a strategic interaction between the companies' payoff to company 1 depends on the actions of

[2] Schelling (1960).
[3] For a good overview of game theory, see Gibbons (1992).

company 2, and vice versa. The outcome where both companies invest, generate high production capacity, thus increasing the likelihood of a fall in oil prices. The payoff in this case is 50 to each of the companies. If they instead were able to coordinate an outcome with lower capacity, oil prices and profits would be higher (100 to each of the companies). The problem with this outcome is that it usually does not represent a stable equilibrium. The reason is that each of the companies has an incentive to invest at high prices. If one company is not investing it will be profitable for the other firm to invest, thus benefiting from the higher oil price. But since investing is the dominant strategy of both companies, the typical Nash-equilibrium is the low-price/high-investment case, where both companies have low profits of 50.

In deciding on its investment levels, an oil company faces a trade-off between the short-term gain of high investments (and high production volumes) in periods of high prices against even-higher long-term profits if both companies were to abstain from additional capacity expansion. Most oil companies have a high required rate of return, which would indicate that they would opt for the short-term strategy of capacity expansion. However, the stock market analysts' system of relative valuation - and emphasis on RoACE - introduces a countervailing incentive, as high investments would generate a temporary decline in RoACE due to the features of the accounting system. Thus, focus on short-term financial indicators (a focal point) may have the interesting effect of supporting an equilibrium of low investments, which otherwise typically is characteristic for companies having low discount rates.

To understand the shift in strategy by the oil companies, towards a stronger focus on short-term rate of return, it is useful to examine the development of share prices among oil and gas companies, relative to other industries.

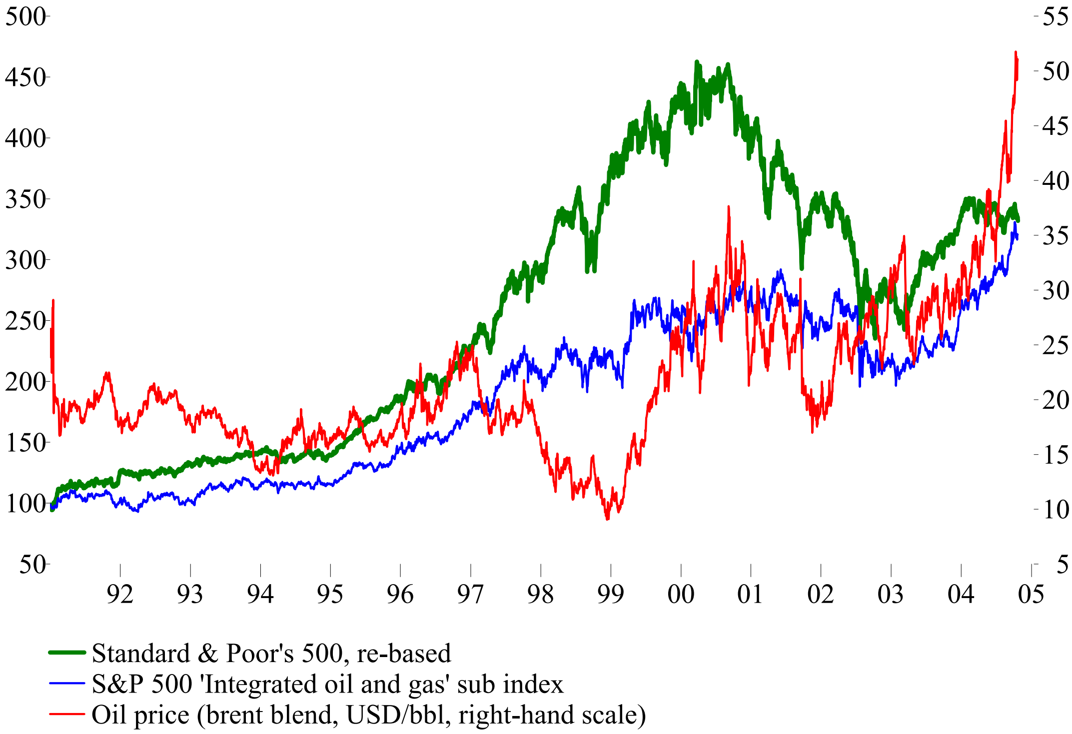

Figure 2: Stock price development for oil companies (Amex OIX) and *general index (S&P500), 1991-2004. Source:* EcoWin.

In Figure 2 wee see that the value of oil stocks fell when oil prices started to fall in 1996, but not to the same extent as the reduction in oil prices One reason could be that the market generally expects the oil price to return to its historical average (mean reversion). The low oil prices, reaching 10 dollars per barrel in 1998, have probably affected the later decisions by international oil and gas companies in terms of low price assumptions in investment analyses.[4] International oil and gas companies have been slow to update price expectations in the aftermath of 1998. Temporary financial distress led to a stronger focus on cost discipline and short-term profitability. When oil prices rose strongly after 1998, the stock market response was muted, and oil and gas stocks general underperformed the general market development. One significant reason for this development was the so-called "new economy". The IT-bubble of the late 1990s made it hard to raise money for conventional risky investments like oil and gas exploration.

4 The very strong focus on cost discipline in the oil industry in the last decade should also be seen in context with over-investment in exploration in the late 1970's and early 1980's.

Moreover, the relative low value of oil stock made acquisition costs for reserves lower than finding and development costs, thus capping the potential for organic growth.[5]

3. RoACE over a project's life cycle

Accounting returns do not always reflect internal rates of return. With the system of depreciations in the oil industry, unit of production depreciation, accounting returns are lower than internal rates of return when investment activity is higher than usual (or for a firm with many new projects in its portfolio). When investments are low (or for firms dominated by legacy assets), accounting returns are higher than internal rates of return. Only at an average investment level (or a balanced portfolio of old and new projects) do accounting returns reflect the internal rate of return. For the oil industry, characterised by large and lumpy investments with long lead times, this is a challenge. It may be hard to get investment funds to good projects in periods where companies are lagging behind their RoACE targets.

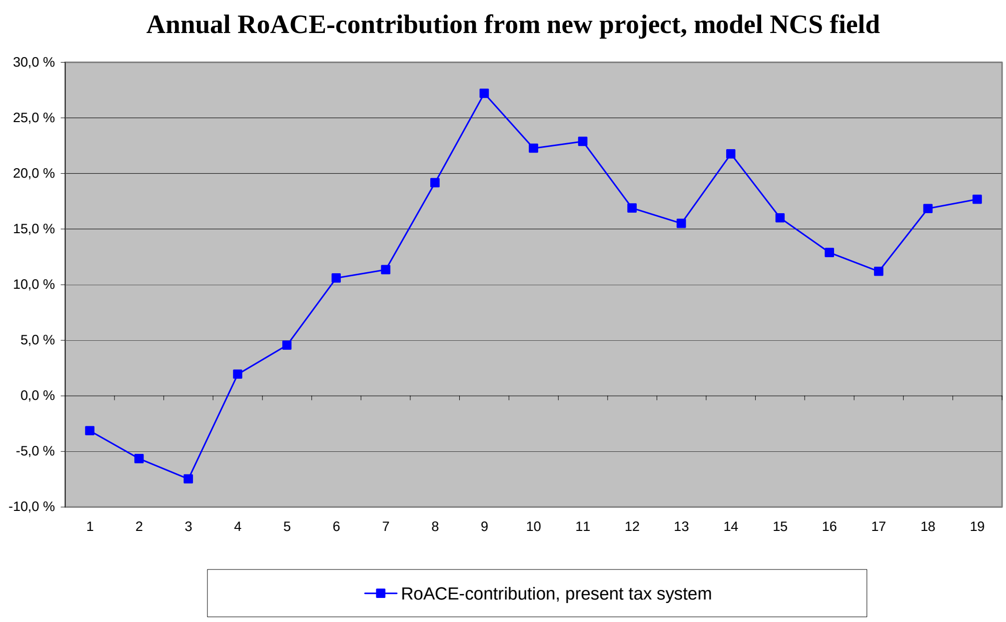

Figure 3: Illustration of RoACE-contribution over a project's life cycle.
Data: Model field from the Norwegian continental shelf.

[5] See Antill and Arnott (2002).

In Figure 3 we provide a simple illustration of how a new project contributes to the RoACE of a small company. The project is a small satellite development on an existing field on the Norwegian continental shelf, requiring relatively small investments and having a very short lead time. For a large company this would have a negligible effect on the RoACE of the entire portfolio (large projects or groups of smaller projects, however, may have a significant impact on RoACE). For illustration purposes, therefore, we have constructed a synthetic portfolio of a small company, consisting of the project and some fixed income. Figure 3 clearly illustrates that the new project will have a negative impact on RoACE in the first years, and thereafter contribute well. Note that this can be seen as a best case for the initial negative impact on RoACE. Larger, stand alone development projects have considerably longer lead times, and hence a longer period of negative RoACE impact. Exploration projects, of course, is even worse in this respect, and may be hard to sell in periods of strong short-term focus.

4. Financial indicators used in the oil industry

Being a successful stock market analyst can be very rewarding, but is indeed also demanding. One single person often has to keep track of a wide range of companies, and provide superior advise and consistent investment recommendations to exacting investors with no concerns but to maximise their returns and to outperform their benchmarks. No wonder, therefore, that both analysts and investors have to relate to some simplified indicators that can help them in developing relative valuations and investment rankings.

Ideally, valuation should be undertaken by means of net present value analyses. The value of a firm is then determined by the cash flow, growth and risk characteristics. As analysts lack the necessary data to do such analyses in a proper manner (asymmetric information), they often resort to relative valuation, in which estimated firm values are based on how similar assets are currently priced in the market. According to Damodaran (2002), the use of relative valuation is widespread. The reasons are that valuation based on multiples can be completed with far fewer explicit assumptions and far more quickly than a discounted cash flow valuation. Furthermore, relative valuation is simpler to understand and easier to present to clients. Finally, relative valuation is much more likely to reflect the current mood of the market, since it is an attempt to measure relative and not intrinsic value.

First we give a brief presentation of the relation between cash flow valuation and valuation by use of multiples. Discounted cash flow (DCF) analysis, which is widely accepted as the ideal theoretical valuation model, can be used to derive valuation multiples such as the price-earnings ratio (P/E) and the enterprise value-free cash flow ratio (EV/FCF). The value of a stable growth firm (enterprise value, EV) is the discounted value of the free cash flow to the firm (FCF):

(1) $$EV = \frac{FCF}{WACC - g},$$

where WACC denotes weighted average cost of capital and g is the growth rate of the cash flow. Dividing by FCF we get the multiple:

(2) $$\frac{EV}{FCF} = \frac{1}{WACC - g}$$

While pre-tax cash flow measures such as EBITDA (earnings before interest, taxes, depreciation and amortization) are commonly used in other sectors, they lack relevance in the oil and gas industry as tax rates differ substantially. Hence, the analysts use a so-called debt-adjusted cash flow measure (DACF), which in its simplest form is a post-tax EBITDA. The free cash flow to the firm can be written in terms of DACF:

(3) FCF = (EBIT (1-t) + DD&A) – (Capex + Δ Working capital),

where DD&A is depreciation, depletion and amortization, capex is capital expenditure and *t* is the tax rate on operating income.

Defining (EBIT (1-t) + DD&A) as DACF and (Capex + Δ Working capital) as long-term (capex) and short-term (working capital) investments, equation 2 becomes:

(4) $$\frac{EV}{DACF} = \frac{1 - \frac{Investments}{DACF}}{WACC - g}$$

Since DACF can be viewed as the funds available for investments (short term and long term), debt repayment and distribution to shareholders, the numerator in the term on the right hand side of the equation, (1-investments/DACF), can be interpreted as the ratio of funds available for repayment of debt and distribution to shareholders. In other words, EV/DACF is positively related to the fraction of available cash flow distributed to debt and equity holders. Note that this relation only applies if all other things are kept equal, i.e., the company remains a stable growth firm. It does not apply, e.g., if increased distribution to equity holders were to negatively affect growth. From the denominator on the right hand side of equation (4) we see that the valuation multiple EV/DACF is increasing with the growth rate in the company's cash flow and decreasing with the company's WACC.

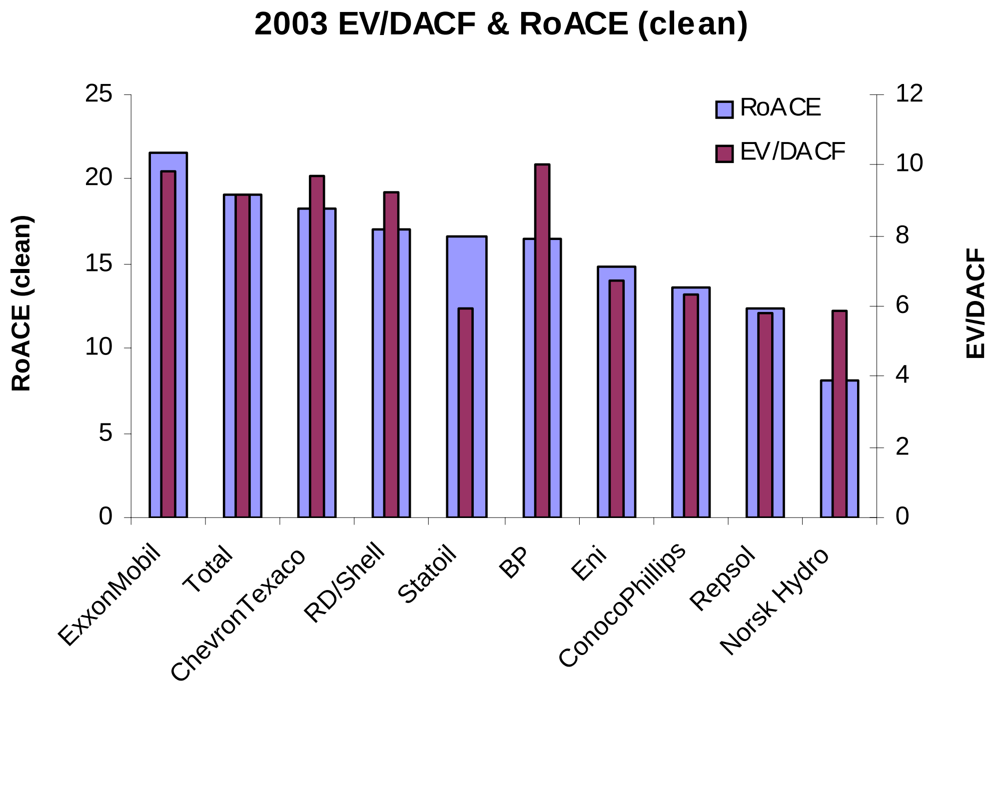

Figure 4: EV/DACF and RoACE ranking for international oil companies, for 2003. Data source: Deutsche Bank.

In Figure 4 we list EV/DACF and RoACE for some international oil companies, ranked according to RoACE. Such benchmarking by investment banks makes oil companies focus on the development in their RoACE-figures. Note that the relation between EV/DACF and RoACE in the diagram is not clear-cut.

A crucial issue for valuation analyses, of course, is to determine the key indicators that may cause valuation multiples to vary across firms in the same sector. For the international oil and gas industry, the most common financial indicators and valuation benchmarks are Return on Average Capital Employed (RoACE), unit cost, production growth, reserve replacement rate, and average tax rate. These indicators can be perceived as a simplified implicit incentive scheme presented to the oil firms by the financial market. In responding to these incentives, the companies need to strike a balance between short-term goals of return on capital and medium- to long-term goals of production growth and reserve replacement.

RoACE is usually defined as net income adjusted for minority interests and net financial items as a percentage ratio of average capital employed, where capital employed is the sum of shareholder's funds and net interest-bearing debt. DACF, or debt-adjusted cash flow, normally reflects after-tax cash flow from operations plus after-tax debt-service payments; where after-tax cash flow is the sum of net income, depreciation, exploration charge and other non-cash items.

Given the data that is available for external analysts, it is common to use market comparative multiple analyses. Cash flow multiples stand out as especially important in this respect, and one widely used indicator is the relation between enterprise value (EV) and debt-adjusted cash flow (DACF) – or EV/DACF. An estimate for the value of a company, P, is thus found by taking the mid-cycle *DACF* for company *i* and multiplying it with the multiple for the comparable companies (peer group), *EV/DACF* . Thus, $P_i=(EV/DACF)xDACF_i$. Positive investment recommendations are awarded to "cheap" companies, where valuation estimates go beyond current market capitalisation. On the other hand, cautiousness is usually recommended for the more "expensive" companies, where simple valuation estimates fall short of their market capitalisation.

In their *Global Integrated Oil Analyzer*, UBS Warburg states: "Our key valuation multiple is EV/DACF". The key arguments are that it is an after-tax value (important in an industry with substantial resource rent taxes) and that it is independent of financing decisions (thus facilitating comparisons between companies with different capital structure).

UBS Warburg also appreciates the influence of oil price volatility on their analysis, and tries to focus on variables that can be influenced by management – i.e. production and unit costs. For valuation purposes, they therefore concentrate on what they call mid-cycle conditions. Given the considerable volatility in oil and gas prices, this is clearly important for the international oil and gas industry. For a given year, UBS Warburg identifies a clear relationship between RoACE and the EV/DACF multiple, and conclude:

"Each of the stocks which we rate a 'Buy' is trading below the average level relative to its returns. EV/DACF versus RoACE provides the key *objective* input into the process of setting our target prices."

Similar statements about valuation, multiples and return on capital are made in Deutsche Bank's publication *Major Oils*.

In presentations of their valuation techniques, investment banks often picture the relationship between market capitalisation (or EV/DACF) and a single financial indicator (like RoACE) in a diagram. They typically show this relationship for different companies at a given point of time. We take this approach a significant step further, by controlling for other variables that can influence the multiple – like reserves etc. Furthermore, we apply a panel data set that offers observations of the relationship over five years. This allows us to test the hypothesis that a firm's reputation is among the most important factor in deciding the company's value. Thereafter, we compare our findings with common analyst perceptions.

5. Previous research

In the following we present literature that specifically deal with valuation of oil companies.[6] McCormack and Vytheeswaran (1998) point out particular problems in valuation of oil companies, since the accounting information in the upstream sector gathered and reported by oil and gas concerns, "does a distressingly poor job of conveying the true economic results". There

[6] For general analyses of valuation multiples, see Damodaran (2002), and Liu, Nissim, and Thomas (2001).

are measurement errors in petroleum reserves. There is an asymmetric response to new information; bad news is quickly reflected in the reserve figures whereas good news takes more time to be accounted for. Moreover, reserves may be exposed to measurement errors since they are noted in current oil price (and not the mid cycle price), and since they do not include the value of any implicit real options. Finally, McCormack and Vytheeswaran claim there is a bias in the reported figures, as the large and profitable oil companies are more conservative in their reserve estimates. This is a factor that can explain the importance that many analysts put on company reputation. However, this assumption has perhaps also become questionable, after the recent reserve write-down in Royal Dutch/Shell.

As for depreciation, with the successful efforts method initial depreciations are too high. The unit of production method also has the effect of depreciating the assets too quickly. The effect may easily be to punish new activity and reward passivity. Other measurement challenges specific to the oil business are cyclical investment patterns and long lead times, which may exacerbate the measurement errors. We may have similar effects from the fact that discoveries are discontinuous and stochastic.

McCormack and Vytheeswaran (1998) perform econometric tests on financial relations for the largest oil companies for the period 1997-2001. Change in shareholder wealth is tested against EBITA, RONA, after-tax earnings, ROE, and free cash flow. The relations between valuation and financial indicators were found to be very weak or non-existent. Stronger relations were established by introducing Economic Value Added (EVA[7]) and reserves.

Antill and Arnott (2002) address the strategic dilemma between return on capital and growth in the petroleum industry. They claim that current RoACE-figures of some 15 per cent are due to the fact that the companies possess legacy assets that have low book values but still generate a considerable cash flow. If market values of the capital employed were applied, they estimate that the rate of return would fall to approx. 8-9 per cent, being more consistent with the cost of raising capital. One problem with RoACE, they add, is that capital employed will always reflect a mixture of legacy and new assets. The implication is that RoACE does not adequately reflect incremental profitability.[8] Thus, it falls short of being a good measure for current performance. Antill and Arnott (2002) argue that the oil companies should accept investment

[7] EVA is a trade mark of Stern Stewart & Co.
[8] Using measures as RoACE thus favors companies having a large fraction of legacy assets in their portfolio.

projects with lower internal rate of return (IRR), as the growth potential would add value to the companies.

Chua and Woodward (1994) perform econometric valuation tests for the American oil industry, 1980-1990. They test P/E-figures for integrated oil companies against dividend payout, net profit margin, asset turnover, financial leverage, interest rate, and Beta. However, they fail to uncover robust relations in the data set. The estimated interactions are weak, and some of them even have different signs than expected. Chua and Woodward do not find support for the P/E-model. They therefore go on to test the stock price against cash flow from operation (following year and preceding year), dividend payout, net profit margin, total asset turnover, financial leverage, interest rate, Beta, and proven reserves. Future Cash flow and proven reserves are statistically significant explanatory factors, thus offering support to a fundamental approach to valuation. An increase in proven reserves of 10% produced an increase in the stock price of 3.7%, in the model estimated by Chua and Woodward.

6. Empirical specification and data set

Our objective is to evaluate the current valuation techniques among stock market analysts and professional investors. Standard analyst reports usually illustrate/compute correlations obtained from a cross-section of companies for one year only. We expand the analyses by making use of time series data for a panel of companies. Our econometric approach also allow for a variety of explanatory factors in a simultaneous model. For example, it is interesting to test how market capitalisation is affected both by return on capital (RoACE) and the reserve replacement rate (RRR). Traditional bilateral correlation studies of EV/DACF may not give the full picture of value generation if there for instance is a negative correlation between RoACE and RRR. Our basic equation to be estimated is

(5) $EV/DACF = a + b\,ROACE + \varepsilon$

where a and b are the parameters to be estimated, and ε is an error term. To investigate the effect of additional variables the model is expanded to

(6) $EV/DACF = a + b ROACE + cX + \varepsilon$

Here, X denotes a vector of additional variables that can influence EV/DACF. This vector may include reserve replacement, oil and gas production (as a proxy for company size), unit production cost, finding and development cost and various combinations of these in different specifications. The equations are estimated with OLS, where fixed effects are used to distinguish between the years when pooling the observations from different years into a panel. An error term is of course added to the specifications before estimation.

For this study, UBS Warburg have kindly provided us with a panel data for the period 1997-2002, including the following companies:

Amerada Hess
BP
ChevronTexaco
Eni
ExxonMobil
Marathon Oil
Norsk Hydro
Occidental
Petro-Canada
Repsol YPF
TotalFinaElf

6.1 Lack of normalisation

In a time series setting, performance evaluation of oil companies would have to adjust for the

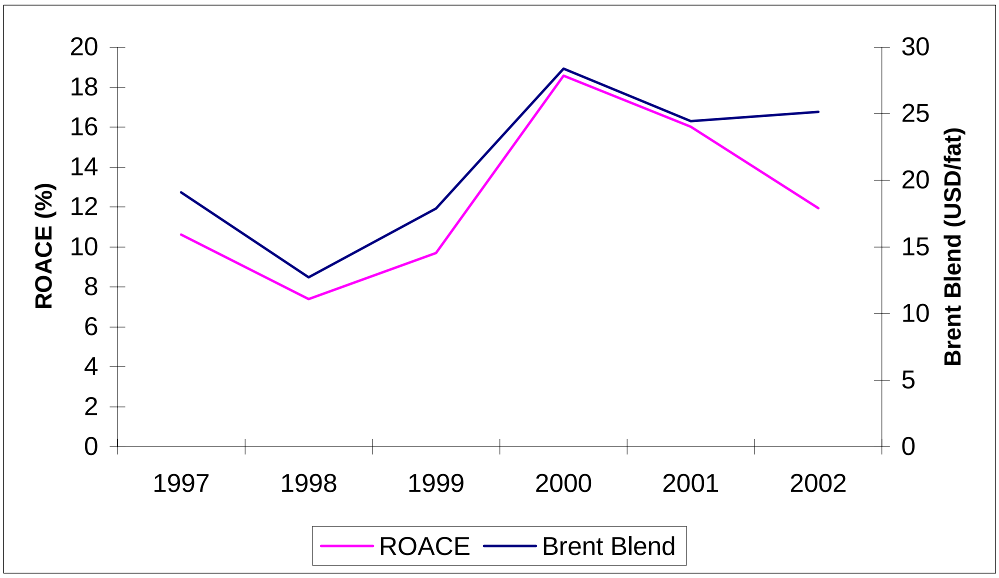

Figure 5: Arithmetic average RoACE versus Brent Blend, 1997-02.[9]

volatilities of oil and gas prices. If a company is performing well, it is vital to know whether it is merely due to a favourable oil market sentiment, or if superior stock market performance can be attributed to real improvements in the company's underlying operations. Such normalisation is crucial also in a cross sectional setting, since normalisation is necessary for comparing companies with different portfolios. Companies are not to the same extent exposed to refinery margins and price fluctuations for oil and gas.

Some oil companies do publish normalised RoACE-figures. In these cases, normalisation procedures and mid-cycle market assumptions will vary across companies. Accordingly, most valuation analyses are based on non-normalised data. To account for the effect of price cycles, they instead emphasise mid-cycle market conditions, which may be seen as a related concept.

Figure 5 indicates that non-normalised RoACE-figures have quite limited information value. Non-normalised RoACE does not seem to provide much beyond the oil price, in this particular time period. In 2001, however, the two figures depart and the spread has widened into 2003. Similar departures might have occurred under previous price cycles. Note also that the diagram is on an aggregate basis, so the non-normalised return from individual companies might provide more information. Still, the benefits of normalised return figures should be obvious.

[9] RoACE is in the UBS dataset defined excluding goodwill amortisation charges from the returns, but goodwill is included in capital employed.

7. Empirical results

The multiple EV/DACF versus the return on capital indicator RoACE are essential to today's standard valuation reports from stock market analysts. As a basis for valuation, UBS Warburg claims to identify a clear, positive relationship between RoACE and the EV/DACF multiple. This relationship is illustrated for the year 2002 in Figure 6. UBS Warburg is unlikely to recommend investing in an oil company unless it is located above the solid line in the figure.

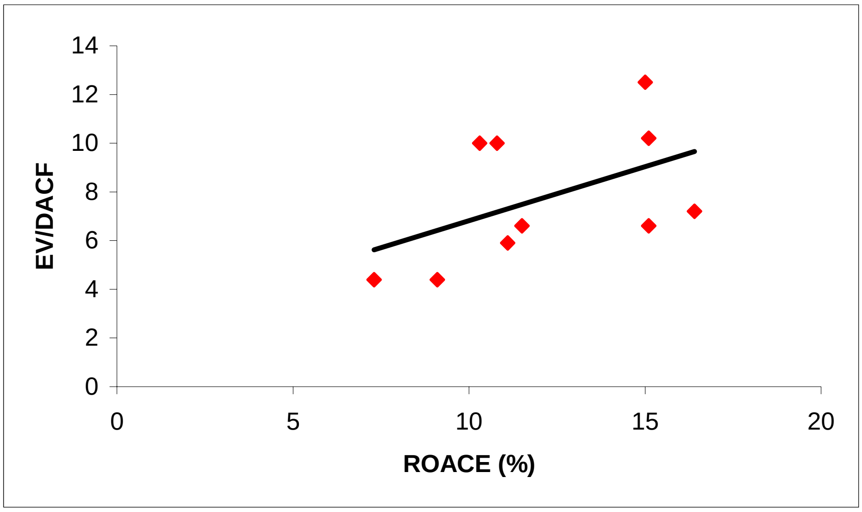

Figure 6: EV/DACF versus RoACE, 2002

Our data set offers support to this relationship for all of the individual years 1997-2002, as reported in Table 2. However, the annual relationship between EV/DACF and RoACE is only weakly significant in the dataset, as the estimated parameter is never significant at a 5% level. The relationship is clearest for 2002. This is shown in Figure 6 and the estimated equation with *t*-values in the parentheses is:

(7) EV/DACF = 1.904 (0.606) + 47.453 (1.885)* ROACE

$R^2 = 0.277$

ROACE is here weakly significant with a *p*-value of 0.069. For the other years the R^2 is lower and although the estimated parameter is positive it is never statistically significant at any conventional level.

Table 2. Year by year regressions of ROACE on EV/DACF

Year	Constant*	ROACE*	R^2
1997	6,427 (4.804)	19,621 (1.670)	0.237
1998	10,795 (5,367)	0,680 (0,029)	0.001
1999	4,795 (1,000)	51,273 (1,069)	0.113
2000	2,791 (0,344)	21,733 (0,501)	0.027
2001	7,069 (1,824)	4,170 (0,180)	0.004
2002	1.904(0.606)	47,453 (1,885)	0.277

* *t*-values in the parenthesis

We would like to take this further, to see if the relationship between EV/DACF and RoACE prevails over time, in a setting with multiple explanatory factors. With straightforward testing on time series data, we cannot establish any correlation between EV/DACF and RoACE. But here we need to take one step back and reflect on our input data. As explained above, we would have liked normalised RoACE-figures. Having only non-normalised return on capital figures at hand, we have to address the issue of oil price fluctuations. With oil companies being priced at mid-cycle oil prices, one would have to assume a strong relationship between the multiple EV/DACF and the oil price, as revealed in Figure 7. When the oil price is very high, the market expects it to fall (mean reversion) and, accordingly, a low multiple is the result. The reverse is the case at very low prices.

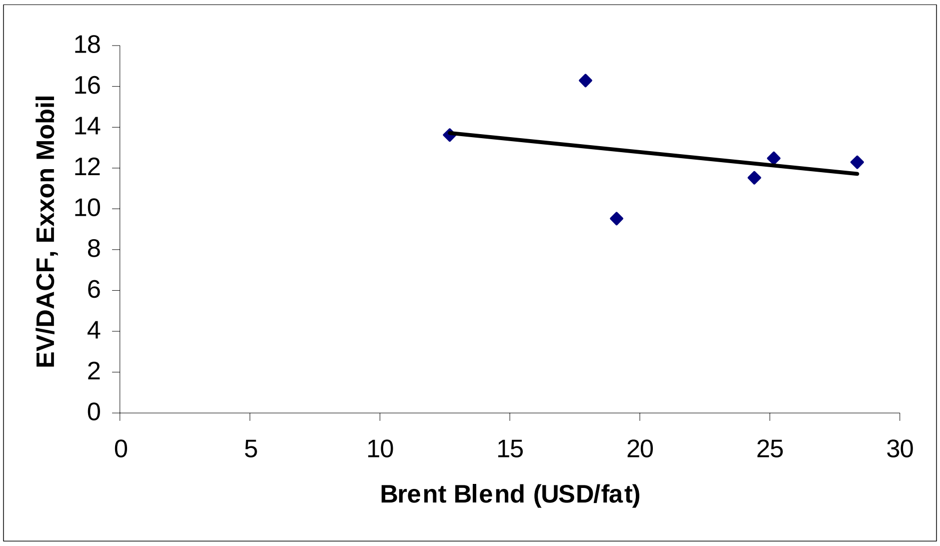

Figure 7: Oil price sensitivity. EV/DACF versus Brent Blend, ExxonMobil, 1997-2002

Consequently, we need to single out oil price volatility to isolate the true effect on valuation from underlying profitability, i.e., the effect of normalised RoACE. One way of achieving this is simply to include oil price in the regression. The coefficient pertaining to RoACE will then reflect the effect on valuation from *normalised* return on average capital employed. Since all international oil companies more or less face the same oil price in a given year, the inclusion of oil price in the regressions is analogous to including a year dummy across the panel. In all estimations using the panel over the 5 years, 2001 is used as the base year. Hence, the annual dummies are to be interpreted as the deviation from 2001.

Introducing year dummies in addition to RoACE, we find from regression analyses on the panel data set that the year dummies are strongly significant whereas RoACE is weakly significant (p-value=0.068) in explaining the multiple EV/DACF; see Table 3. However, the explanatory power is still relatively poor with an R^2 of 0.26.

Table 3. EV/DACF explained by ROACE and annual dummies

Variable	Coefficient	t-value
Constant	4.833	2.367
ROACE	22.178	1.869
y97	1.465	1.011
y98	4..764	2.913
y99	3.094	2.078
y00	-1.954	-1.408

This is the only specification using the panel where ROACE is positive. With a p-value of 0.068 the parameter is also statistically significant at a 10% level although not at a 5% level. Note that we find significant year effects, i.e., EV/DACF responds negatively to oil price, as in Figure 7. This supports the perception that oil companies are priced at mid cycle oil prices.

We would like to examine the trade-off between short-term return (RoACE) and growth (reserve replacement rate, RRR). The results from this specification is reported in Table 4. The explanatory power for this specification is still poor with an R^2 of 0.28. RoACE is weakly significant, and with a negative sign. On the other hand, the RRR coefficient takes s the sign we would expect, but is not significant in explaining valuation. Hence, the classical short-term, long-term trade-off is not sufficient to generate a valid valuation model in the oil industry for the relevant period. One possible explanation to the fact that RoACE is only weakly significant, and with a negative sign, would be that the strong focus on RoACE in the years 1997-2002 has been at the expense of organic reserve replacement. The valuation multiple, therefore, has not responded favourably in response to high RoACE figures, since the investors have not perceived the higher returns to be sustainable. This explanation, however, of a stock market primarily concerned with long term potential, is not supported by our tests.

Table 4. EV/DACF explained by ROACE, RRR, and annual dummies

Variable	Coefficient	*t*-value
Constant	4.0213	1.789
RoACE	21.059	1.76
y97	1.5087	1.038
y98	4.6535	2.83
y99	2.8929	1.915
y00	-1.9709	-1.416
RRR	0.81509	0.874

Many analysts argue that company size plays an important part in pricing of international oil companies. Various practical and theoretical reasons have been provided to explain this fact. We will mention some of them. Larger companies may have a larger growth potential in their portfolios. Company size may have a positive reputational effect on governments' discretionary licensing decisions for oil and gas deposits. Large and prospective operatorships, which also are skill and resource demanding, are often awarded to the largest companies. A larger opportunity set in terms of geological deposits may also allow large firms to pursue a cream-skimming strategy. Finally, the largest international oil companies have the best opportunities to pursue tax shifting. On the other hand, large companies may be slow and face higher co-ordination costs, and may miss out on benefits of focusing strategies and specialisation.

Table 5. EV/DACF explained by ROACE, O&G, RRR, and annual dummies

Variable	Coefficient	t-value
Constant	7,4245	5,004

ROACE	-17,936	-1,998
y97	0,22061	0,236
y98	1,8699	1,706
y99	1,0131	1,03
y00	-0.56823	-0,633
RRR	0,32697	0,551
O&G	0,0019059	8,086

We now investigate the effect of size on oil company pricing in our dataset, using total oil and gas production (O&G) as a proxy for size. The results are reported in Table 5. The explanatory power of this specification is substantially improved relative to the earlier specifications, as the R^2 is 0.72. We can see that size is a highly significant explanatory factor in the pricing of oil companies. Note that the sign of RoACE now is significantly negative. This may be due to a likely correlation between RoACE and O&G, to be explored below. An alternative explanation is that firms that improve their short-run profitability (RoACE) do so by scarifying their long-run potential (RRR), and are accordingly punished by investors. With unit of production depreciations, which is the accounting standard, new investments imply a temporary decline in RoACE.

Table 6. EV/DACF explained by ROACE, F&D, O&G, RRR, UPC and annual dummies.

Variable	Coefficient	t-value
Constant	10.183	3.808
ROACE	-19.230	-2.074
y97	0.149	0.156
y98	1.622	1.387
y99	0.660	0.642
y00	-0.681	-0.745
O&G	0.002	7.046
F&D costs	-0.021	-0.357
RRR	0.136	0.178
UPC	-0.526	-1.310

We proceed by including the potential explanatory factors finding & development costs (F&D) and unit production costs (UPC). The results for this specification are reported in Table 6. The explanatory power does not improve much, as the R^2 is 0.73, which is not too surprising given that none of the parameters on the new variables are statistically significant. Note that the perceived relationship between EV/DACF and RoACE remains negative and statistically significant. This might not be so surprising, after all. Production volumes and unit costs affect return on capital and can be influenced by the companies and their management. They are therefore likely to be correlated with RoACE. The implication is that the specific effects of these variables can be hard to identify econometrically. More specifically the effect of RoACE on EV/DACF may be crowded out by the underlying return on capital variables.

Table 7. RoACE explained by F&D, O&G RRR, UPC and annual dummies

Variable	Coefficient	t-value
Constant	0.12735	3,152
O&G	1.46E-05	3,916
F&D_costs	0.0011241	1,141
RRR	0.01112	0,868
UPC	-0.0050038	-0,744
y97	-0.045242	-3,133
y98	-0.083414	-5,652
y99	-0.057084	-3,847
y00	0.033583	2,321

To look further into the potential correlation between RoACE and the other explanatory factors, we try to explain RoACE by these factors. The results for this specification are reported in Table 7. The explanatory power is relatively good, with an R^2 of 0.72. We see that size, represented by O&G, is a highly significant explanatory factor together with the annual dummies. F&D, UPC and RRR are not statistically significant. Hence, it seems like it is primarily the firm size and the oil price that are explaining the variation in RoACE.

Table 8. EV/DACF explained by O&G, F&D, RRR, UPC, annual dummies, and company dummies

Variable	Coefficient	t-value
O&G	0.0010499	0.77
F&D_costs	-0.010579	-0.163
RRR	0.11513	0.127
UPC	-0.59148	-0.963

Hess	7.7361	2.607
BP	11.726	2.359
Chevron	8.5612	1.959
ENI	7.2749	2.348
Exxon	9.2843	1.467
Hydro	7.2656	2.765
Occidental	9.8837	3.53
PetroC	7.3789	3.046
Repsol	9.6002	3.042
TotalFinaElf	8.6209	2.287
Y97	0.7743	0.865
Y98	2.9693	3.487
Y99	1.6338	1.91
Y00	-1.3472	-1.717

To investigate the effect of the firm's reputation, we now run EV/DACF against the various explanatory factors, excluding RoACE, but including company dummies. The results for this specification are reported in Table 8. The explanatory power is now very high, with an R^2 of 0.98. In this regression each company has its own constant term, where a large constant term indicates a higher EV/DACF for that company that cannot be attributed to any of the other factors. Note that this ranking of company effects deviates from traditional EV/DACF rankings, where the largest companies tend also to have the highest multiples. Occidental has the highest company effect, and a company like Hydro outperforms Exxon. With the inclusion of O&G in the regression, we have accounted for the effect of size, and by this isolated reputation effects beyond size. It is worthwhile to note that none of the explanatory variables with the exception of the firm and annual dummies are significant. When testing whether these parameters jointly are zero, we get an $F(4,32)$ statistic of 20.362. With a p-value of 0.834, we cannot reject the hypothesis that these factors should be excluded from out model.

Table 9. EV/DACF explained by annual dummies and company dummies

Variable	Coefficient	t-value
Hess	5.536	6.370
BP	13.396	15.414
Chevron	8.836	10.167
ENI	6.316	7.267
Exxon	11.836	13.619
Hydro	5.736	6.600
Occidental	7.936	9.131

PetroC	5.756	6.623
Repsol	7.616	8.763
TotalFinaElf	9.236	10.627
Y97	0.400	0.545
Y98	2.991	4.071
Y99	1.850	2.519
Y00	-1.223	-1.661

In Table 9 we report the results when explaining EV/DACF only by firm and annual effects. We then get the traditional result that the largest firms have the most significant company effects. The explanatory is still high, with an R^2 of 0.98. BP and ExxonMobil have by far the highest scores. That is, all things equal, ExxonMobil and BP trade at a premium to the rest of the industry.

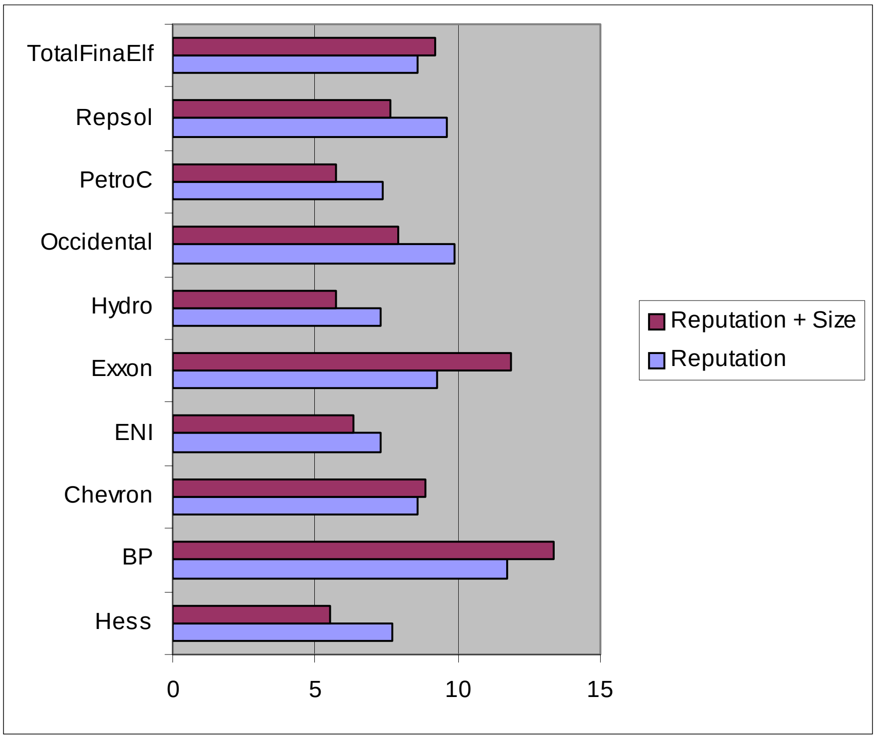

Figure 8: Effects of company size and reputation on pricing of international oil companies.

Note that the simplified regression in Table 9, containing only year dummies (accounting for oil prices) and company dummies, have a very high explanatory power, and appears to be the model that best explains the companies' multiples. This is somewhat surprising, as we are not able to pick up any effect of the variables that are thought to be the most important when valuing oil companies. A likely reason for this is, as argued by McCormack and Vytheeswaran (1998) , that the reported accounts often do not contain very much information, and it is necessary to adjust the accounts substantially to obtain accurate information about the true financial shape of the companies. As oil companies must have a long-run perspective, it is then only natural that with a relatively short data set as ours, the companies that have the best reserves and prospects in 1997 is the same as in 2001, and that the firm effect is the most important explanatory factor.

8. Conclusion

Do low investments and high oil prices represent a sustainable equilibrium for the non-OPEC oil companies? The equilibrium rests on a vital assumption that return on capital employed (RoACE) is the main indicator when capital markets price oil companies. (Market analysts' RoACE-ranking of the international oil companies may have constrained new investments, as investments typically generate a temporary drop in RoACE.) To test this hypothesis we have undertaken regression analyses on market and accounting data from oil companies for the years 1997-2002. The objective is to ascertain key valuation drivers. The valuation multiple EV/DACF is tested against a number of financial indicators and dummy variables. Making use of year dummies in addition to RoACE, we find from regression analyses on the panel data set that the year dummies (reflecting the oil price) are strongly significant, i.e., EV/DACF responds negatively to the oil price. This supports the perception that oil companies are priced at mid cycle oil prices.

The effect of RoACE on the valuation multiple, however, is not in accordance with common perceptions. In our multivariate specifications there is a significant *negative* relation between EV/DACF and RoACE. We have offered some possible explanations to this result. First, the RoACE figures used in external analyses (and in our regressions) are non-normalised. To evaluate performance we would have preferred to normalise for changes in refinery margins and petroleum prices. Such data, generated in a consistent manner, are not readily available. Second, the RoACE figures suffer from the traditional shortcomings that financial accounts have in measuring true profitability (measurement errors). Third, in a multivariate econometric specification, the effect of short-term return on capital can be crowded out by interdependent explanatory factors. Fourth, the high RoACE figures in this period may prove to be non-sustainable, as ambitious return on capital targets effectively reduce the investment capacity. The last explanation seems to be acknowledged by many of the international oil companies, as we now see less emphasis on RoACE and more emphasis on risk-taking and reserve replacement strategies in business plans. This indicates that the current low-capacity/high-price equilibrium is not sustainable.

We obtain strongly significant company effects. To a considerable extent, these coincide with company size, where large companies obtain higher valuation multiples. In addition, we find a significant company reputation effect. A simplified valuation model that includes only year dummies (accounting for oil price) and company dummies (accounting for size and reputation) proves to have a very high explanatory power.

As indicated above, this paper is an early attempt to substantiate the links between market valuation and financial and operational indicators in the international oil and gas industry. The results are inspiring, but preliminary. We still have a long way to go, to develop high-quality data sets and uncover the true data-generating processes. Future research should be directed at the development of broader panels for a longer time-horizon. More degrees of freedom would allow for more sophisticated modelling, without loss of quality in the results.

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